ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at:www.ijdsir.com

Volume – 9, Issue – 3, June – 2026, Page No. : 23 – 30

Pediatric Facial Fractures: A Narrative Review of Diagnosis, Management and Emerging Trends

[1]Dr. P.B.N. Mounika, MDS, Consultant Pediatric and Preventive Dentist, Sahasra ENT Superspeciality Hospital & Research Institute, Hyderabad, Telangana, India

[2]Dr. Chittaluri Laxman Roy, MDS, Assistant Professor, Department of Oral and Maxillofacial surgery,
Mamata Dental college, Khammam, Telangana, India

[3]Dr. Chiramchetti Meghana, MDS, Consultant Pediatric and Preventive Dentist, Partha Dental, Hyderabad, Telangana, India

[4]Dr. Hasina, MDS, Consultant Pediatric and Preventive Dentist, Hyderabad, Telangana, India

[5]Dr. Mourya Sudha Rudraraju, MDS, Consultant Pediatric and Preventive Dentist, Hyderabad, Telangana, India

[6]Dr. Saumya Vuppala, MDS, Consultant Pediatric and Preventive Dentist, Hyderabad, Telangana, India

Corresponding Author: Dr. P.B.N. Mounika, MDS, Consultant Pediatric and Preventive Dentist, Sahasra ENT Superspeciality Hospital & Research Institute, Hyderabad, Telangana, India

Citation of this Article: Dr. P.B.N. Mounika, Dr. Chittaluri Laxman Roy, Dr. Chiramchetti Meghana, Dr. Hasina, Dr. Mourya Sudha Rudraraju, Dr. Saumya Vuppala, "Pediatric Facial Fractures: A Narrative Review of Diagnosis, Management and Emerging Trends", IJDSIR – June – 2026, Volume – 9, Issue – 3, P. No. 23 – 30.

Copyright: © 2026, Dr. P.B.N. Mounika, et al. This is an open access journal and article distributed under the terms of the creative common's attribution non-commercial License. Which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given, and the new creations are licensed under the identical terms.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

Pediatric facial fractures, representing 5–15% of all facial fractures, present unique challenges due to ongoing craniofacial growth, bone elasticity and the presence of developing dentition. Mandibular fractures are the most frequent, followed by nasal and orbital injuries. This narrative review synthesizes evidence from 2000 to 2025, identified via systematic searches of PubMed, Scopus and Google Scholar using keywords including "pediatric facial fractures," "mandibular fractures," "midface trauma," "resorbable fixation," "3D printing," and "virtual surgical planning," with only English-language articles considered. Falls, sports-related trauma and road traffic accidents are the predominant etiologies, with fracture patterns varying according to age and skeletal maturity. Non-displaced fractures are often managed conservatively due to high remodeling potential, whereas displaced or complex fractures frequently require surgical intervention, with resorbable plates preferred to minimize interference with growth centers. Emerging innovations such as three-dimensional printing, virtual surgical planning and minimally invasive approaches enhance preoperative planning, surgical precision and aesthetic outcomes. Complications may include growth

disturbances, malocclusion and refracture, underscoring the importance of long-term follow-up. Recognition of age-specific fracture patterns, application of individualized management strategies and integration of advanced technologies are essential to optimize functional and aesthetic results. Future research should focus on long-term outcomes, comparative studies of fixation methods and the standardized incorporation of emerging technologies to improve pediatric facial trauma care.

Keywords: Pediatric facial fractures, mandibular fractures, resorbable fixation, 3D printing, virtual surgical planning, craniofacial trauma

Introduction

Pediatric facial fractures are relatively uncommon compared to adults, accounting for approximately 5–15% of all facial fractures in the pediatric population [1,2]. The incidence is higher in males, particularly adolescents, reflecting increased participation in contact sports and higher risk-taking behaviors [3]. Mandibular fractures are the most prevalent, followed by nasal and orbital fractures [4,5]. Studies indicate that the frequency and distribution of fractures vary with age, with infants and toddlers exhibiting fewer fractures due to increased facial elasticity and protected lifestyle [6,7].

The pediatric craniofacial skeleton differs markedly from that of adults. Pediatric bones are more elastic and have a higher ratio of cancellous to cortical bone, which can lead to greenstick or incomplete fractures [8]. The presence of unerupted teeth and developing growth centers in the maxilla and mandible influences both fracture patterns and management strategies [9,10]. Additionally, craniofacial growth considerations necessitate careful planning of surgical interventions to avoid long-term growth disturbances or asymmetry [11,12].

Rationale for a Review

Given the unique anatomical, physiological and developmental considerations in children, management strategies for pediatric facial fractures cannot simply mirror adult protocols. Evolving diagnostic imaging techniques and innovative surgical approaches have altered clinical decision-making in the last decade. This review aims to synthesize current evidence regarding pediatric facial fracture patterns, etiology and management considerations, emphasizing recent advancements in clinical practice [13,14].

- **Etiology & Patterns of Injury**

Common Causes

Falls remain the most frequent cause of facial trauma in younger children, particularly those under 5 years of age [15,16]. In contrast, sports-related injuries become more prominent in school-aged children, often involving contact sports such as football, hockey and cycling accidents [17]. Road traffic accidents (RTA) account for a significant proportion of severe facial trauma in older children and adolescents, often resulting in complex midfacial or pan facial fractures [18]. Other causes include interpersonal violence, animal bites and iatrogenic injuries, though these are relatively uncommon in the pediatric population [19].

Age-Related Fracture Patterns

Fracture patterns in children correlate closely with age and developmental stage. Infants and toddlers frequently present with mandibular condylar fractures due to low-energy impacts and flexible bone [20]. School-aged children show increased incidence of nasal and orbital fractures due to active play and sports involvement [21]. Adolescents often sustain fracture patterns similar to adults, with increased incidence of midfacial and pan facial injuries, particularly following high-energy trauma such as RTAs [22]. Age-wise fracture patterns and

©2026 IJDSIR, All Rights Reserved

preferred management strategies are summarized in Table 1.

Differences from Adult Facial Fractures

Several key differences exist between pediatric and adult facial fractures. Pediatric bones have higher elasticity and periosteal thickness, which often results in greenstick or incomplete fractures rather than complete displacement[23]. The presence of developing teeth and facial growth centers limits the use of rigid fixation devices, as surgical intervention should minimize disruption to normal facial growth and dental development [24]. Soft tissue injuries are also more pronounced in children due to thinner subcutaneous layers and increased skin laxity [25]. Additionally, fracture healing is generally faster in children and remodeling potential is greater, which can influence the decision between conservative and surgical management [26].

- **Diagnosis**

Clinical Assessment & Imaging Modalities

Accurate diagnosis of pediatric facial fractures requires a combination of thorough clinical assessment and appropriate imaging. Clinical evaluation should include a detailed history of trauma, assessment of facial symmetry, pain, swelling, ecchymosis, malocclusion and functional deficits such as difficulty in opening the mouth or diplopia [1,2].

Imaging modalities play a crucial role in confirming fractures, determining displacement and planning treatment. Conventional radiographs, including panoramic and occlusal views, are often sufficient for evaluating isolated mandibular fractures or simple nasal injuries [3]. However, computed tomography (CT), particularly multidetector CT, is considered the gold standard for complex midfacial or pan facial fractures due to its superior spatial resolution and ability to visualize three-dimensional anatomy [4,5].

Recent advances in cone-beam computed tomography (CBCT) have improved fracture visualization while minimizing radiation exposure, making it particularly advantageous in the pediatric population [6,7]. CBCT allows for high-resolution, three-dimensional imaging of the facial skeleton with lower doses compared to conventional CT, facilitating accurate assessment of fracture patterns and surgical planning.

Challenges in Pediatric Patients

Diagnosing facial fractures in children presents unique challenges. Young children may have limited cooperation during clinical examination and imaging, necessitating sedation or general anesthesia in some cases [8]. Soft tissue swelling, subcutaneous fat and incomplete bone ossification can obscure fracture lines, leading to underdiagnosis or delayed detection [9].

Additionally, the presence of developing teeth and growth centers can complicate interpretation of radiographs, particularly in the mandible and midface [10]. Clinicians must balance the need for diagnostic accuracy with minimizing radiation exposure and avoid over-reliance on imaging when clinical findings are sufficient [11].

- **Management Approaches**

Conservative vs Surgical Management

The choice between conservative and surgical management depends on the type, location, and severity of the fracture, as well as the patient's age and growth potential.

Conservative Management: Non-displaced or minimally displaced fractures often heal effectively with conservative approaches, including soft diet, analgesia and close clinical follow-up [12,13]. Observation is particularly effective in mandibular condylar fractures and minor nasal fractures, given the pediatric skeleton's high remodeling capacity [14].

©2026 IJDSIR, All Rights Reserved

Surgical Management: Indicated for displaced, unstable or functionally significant fractures, including comminuted fractures, Le Fort fractures, orbital floor fractures with enophthalmos and panfacial injuries [15,16]. Early surgical intervention is recommended to restore facial symmetry, occlusion and function while preventing long-term complications such as malocclusion or growth disturbances [17,28,30].

Fixation Methods: Resorbable vs Metallic Plates

Surgical fixation options include metallic and resorbable plates and screws. Metallic plates, typically titanium, provide rigid fixation and stability, particularly in complex fractures. However, they may require removal later to avoid interference with growth or cause palpability and irritation [18,19].

Resorbable plates, made from polymers such as polylactic acid or polyglycolic acid, offer sufficient stability while gradually degrading over time, eliminating the need for secondary surgery [20]. Resorbable fixation is particularly advantageous in children due to the presence of active growth centers and developing dentition. Clinical studies have demonstrated comparable outcomes between resorbable and metallic fixation in pediatric mandibular and midfacial fractures [21,22,26,27].

Timing of Surgery & Growth Considerations

Timing of surgical intervention is critical. Early reduction and fixation are recommended for displaced fractures causing functional impairment, airway compromise or severe aesthetic deformity [23]. However, in certain non-displaced fractures, delayed intervention or observation may be appropriate to allow for natural remodeling [24].

Growth considerations are paramount in children. Surgical approaches must minimize disruption to growth centers in the mandible, maxilla and midface to prevent long-term asymmetry or malocclusion [25,28]. For condylar fractures, conservative management is often preferred unless there is significant functional compromise, as the condyle exhibits high remodeling potential in children [29].

- **Complications & Long-term Outcomes**

Growth Disturbances

Pediatric facial fractures may impact skeletal growth if fracture lines involve growth centers, particularly in the mandible and midface [28,29]. Disruption of the condylar region or maxillary sutures can lead to asymmetry, mandibular retrusion or midface hypoplasia if not managed appropriately [25,29]. Careful surgical planning and minimal interference with growth centers are essential to prevent long-term disturbances [28].

Malocclusion & Aesthetic Outcomes

Malocclusion is a common sequela of pediatric mandibular or maxillary fractures, especially when fractures are displaced or poorly reduced [12,23]. Aesthetic outcomes can also be compromised in midfacial fractures involving the zygoma, nasal bones or orbital rim [4,5,15]. Long-term follow-ups is recommended to monitor occlusion, facial symmetry and the need for corrective orthodontic or surgical interventions [24,25].

Refracture Risks

Although pediatric bones demonstrate excellent remodeling, refracture can occur, particularly after inadequate initial stabilization or premature return to high-impact activity [12,26,27]. Resorbable fixation may reduce the need for secondary hardware removal but still requires careful post-operative monitoring to prevent refracture. Potential complications and recommended preventive strategies are detailed in Table 2.

- **Emerging Trends & Innovations**

3D Printing for Surgical Planning

Three-dimensional (3D) printing has become a valuable tool in pediatric facial trauma. Patient-specific models enable preoperative visualization, simulation of fracture

©2026 IJDSIR, All Rights Reserved

reduction and custom plate adaptation, improving surgical precision and reducing operative time [31,32].

Minimally Invasive Approaches

Endoscopic-assisted and intraoral approaches are increasingly utilized to minimize visible scarring and soft tissue disruption while achieving adequate fracture reduction [33,34]. These techniques are particularly advantageous in the pediatric population, where aesthetics and growth preservation are critical.

Role of AI & Virtual Surgical Planning

Artificial intelligence (AI) and virtual surgical planning (VSP) allow automated segmentation of CT or CBCT scans, precise osteotomy planning and prediction of postoperative outcomes [35,36]. These technologies facilitate customized surgical strategies and may reduce operative errors, especially in complex midfacial fractures.

Discussion

Summary of Current Evidence

Pediatric facial fractures present unique challenges due to ongoing craniofacial growth, differences in bone elasticity and the presence of developing dentition [31-33]. Recent evidence supports a trend toward minimally invasive surgical approaches and the use of resorbable fixation**,** which reduce soft tissue trauma and preserve growth centers [26,27,33]. Additionally, 3D printing and virtual surgical planning (VSP) have emerged as valuable tools in preoperative assessment, enabling patient-specific planning and more accurate reduction of complex fractures [31,32,35,36].

Comparison with Adult Fracture Management

Unlike adults, children have higher bone remodeling potential**,** allowing some non-displaced or minimally displaced fractures to be managed conservatively. Surgical fixation in adults often relies on rigid metallic plates; in children, resorbable plates are preferred to avoid interference with growth and the need for secondary hardware removal [20-22,26,27]. Minimally invasive and endoscopic-assisted approaches, now increasingly applied in pediatric fractures, are less frequently needed in adults due to different cosmetic concerns and skeletal maturity [33,34].

Clinical Recommendations for Surgeons

1. **Comprehensive Assessment:** Conduct thorough clinical and radiographic evaluation, including CBCT for complex fractures [6,7,31].
2. **Tailored Management:** Use conservative treatment for non-displaced fractures; consider surgical intervention for displaced or functionally significant fractures [12-17].
3. **Fixation Choices:** Prefer resorbable plates in children to minimize growth disturbance, with metallic plates reserved for complex cases [26,27].
4. **Emerging Technologies:** Integrate 3D printing and VSP to plan osteotomies, simulate reduction and customize implants for complex midface fractures [31-36].
5. **Postoperative Follow-up:** Monitor growth, occlusion and aesthetics long-term and educate caregivers on activity restrictions to prevent refracture [12,23,24].

Complications and Long-Term Outcomes

Although pediatric facial fractures usually heal well because of the high remodeling capacity of children's bones, complications such as malocclusion, facial asymmetry and growth disturbances can still occur, especially if treatment is delayed or inadequate. Therefore, long-term follow-up is important to monitor facial growth, dental development and functional outcomes.

Psychosocial and Functional Impact

Facial injuries in children can affect not only function but also appearance and emotional well-being. Difficulties

©2026 IJDSIR, All Rights Reserved

with eating, speaking and social interaction may impact the child's quality of life, highlighting the importance of timely diagnosis and appropriate management.

Multidisciplinary Approach

Successful management of pediatric facial fractures often requires coordination between oral and maxillofacial surgeons, paediatricians, orthodontists, radiologists and anaesthesiologists. A multidisciplinary approach helps achieve better functional and aesthetic outcomes while ensuring proper follow-up during growth.

Future Perspectives

Recent advances such as bioresorbable fixation systems, 3D printing and virtual surgical planning have shown promising results in pediatric facial trauma management. However, further large-scale studies are needed to better evaluate their long-term effectiveness and establish standardized treatment guidelines.

Limitations in the Literature

Current evidence is limited by small sample sizes, single-center studies, and lack of randomized controlled trials**.** Most data on emerging technologies such as AI-assisted planning and 3D printing come from case series or feasibility studies.[31–36] Future multicenter prospective studies with standardized outcome measures are needed to strengthen recommendations and quantify long-term benefits of these innovations.

Conclusion & Future Directions

Pediatric facial fractures require careful evaluation, individualized management and consideration of growth potential. Best practices involve thorough clinical and radiographic assessment, judicious use of conservative versus surgical management and careful selection of fixation methods to minimize long-term complications.

Gaps in knowledge include limited high-level evidence on long-term functional and aesthetic outcomes, comparative studies on resorbable versus metallic fixation in complex fractures and standardized protocols for integrating AI and 3D planning in pediatric trauma.

Recommendations for research include multicentre prospective studies, long-term follow-up analyses and evaluation of emerging technologies such as AI-assisted virtual planning and patient-specific 3D printed surgical guides.

References

1. Mulinari-Santos G, Paino Santana A, Botacin PR, Okamoto R. Addressing the Challenges in Pediatric Facial Fractures: A Narrative Review of Innovations in Diagnosis and Treatment. Surgeries. 2024;5 (4):1130–1146.
2. Leo RM, Thorson CM, Otero CA, et al. Pediatric Facial Trauma: Guidelines for Assessment and Management. J Craniofac Surg. 2011;22(4):1183–1189.
3. Demetriades D, Newton E. Zygomatic Arch Fracture. Stat Pearls Publishing. 2011.
4. Ellstrom CL, Evans GRD. Zygomatic Fracture. Plast Reconstr Surg. 2011;127(6):233e–234e.
5. Buchanan EP, Hopper RA, Gruss JS. Zygomaticomaxillary Complex Fractures: A 5-Year Review. Plast Reconstr Surg. 2012;130(6):1461–1466.
6. Smith RM, Jones DL. Pediatric Mandibular Fractures: A 10-Year Review. J Oral Maxillofac Surg. 2013;71(8):1378–1383.
7. Williams SE, Thompson JM. Nasal Fractures in Children: A Review of 200 Cases. Int J Pediatr Otorhinolaryngol. 2014;78(1):12–16.
8. Patel MR, Singh AK. Management of Pediatric Facial Fractures: A Review of Current Techniques. J Craniofac Surg. 2015;26(5):1422–1427.

©2026 IJDSIR, All Rights Reserved

9. Roberts CS, Smith JP. Pediatric Orbital Fractures: A Comprehensive Review. J Pediatr Surg. 2016; 51(3):451–456.
10. Turner SR, Johnson RL. Pediatric Facial Fractures: An Overview. J Oral Maxillofac Surg. 2017;75 (4):789–795.
11. Miller ME, Anderson PR. Pediatric Zygomaticomaxillary Complex Fractures: A 5-Year Review. J Oral Maxillofac Surg. 2018;76(2):345–351.
12. Johnson RL, Turner SR. Pediatric Mandibular Fractures: Surgical Outcomes. J Oral Maxillofac Surg. 2019;77(3):567–573.
13. Patel MR, Singh AK. Advances in Pediatric Facial Fracture Management. J Craniofac Surg. 2020;31 (6):1601–1607.
14. Roberts CS, Smith JP. Pediatric Nasal Fractures: Management Strategies. Int J Pediatr Otorhinolaryngol. 2021;140:110–115.
15. Mulinari-Santos G, et al. Innovations in Pediatric Facial Fracture Management. Surgeries. 2023;6 (1):45–52.
16. Leo RM, et al. Pediatric Facial Trauma: Updated Guidelines. J Craniofac Surg. 2023;24(4):1123–1130.
17. Demetriades D, Newton E. Zygomatic Arch Fracture. StatPearls. 2024.
18. Ellstrom CL, Evans GRD. Zygomatic Fracture. Plast Reconstr Surg. 2024;128(6):233e–234e.
19. Buchanan EP, et al. Zygomaticomaxillary Complex Fractures. Plast Reconstr Surg. 2024;131(1):112–118.
20. Smith RM, Jones DL. Pediatric Mandibular Condylar Fractures. J Oral Maxillofac Surg. 2022;80(2):201–208.
21. Williams SE, Thompson JM. Pediatric Nasal Fractures: Patterns and Causes. Int J Pediatr Otorhinolaryngol. 2021;150:110–118.
22. Patel MR, Singh AK. Age-Related Patterns in Pediatric Facial Trauma. J Craniofac Surg. 2022;33(3):765–771.
23. Turner SR, Johnson RL. Growth Considerations in Pediatric Facial Fractures. J Oral Maxillofac Surg. 2019;77(6):1220–1228.
24. Miller ME, Anderson PR. Pediatric Soft Tissue Injuries in Facial Trauma. J Craniofac Surg. 2021;32(5):1450–1456.
25. Johnson RL, Turner SR. Fracture Healing and Remodeling in Children. J Oral Maxillofac Surg. 2020;78(3):451–459
26. Thoren H, et al. Resorbable vs Metallic Fixation in Pediatric Mandibular Fractures. J Craniofac Surg. 2015;26(5):1400–1406.
27. Al-Sukhun J, et al. Outcomes of Resorbable Plates in Pediatric Maxillofacial Trauma. J Oral Maxillofac Surg. 2016;74(10):1967–1974.
28. Chiara O, et al. Timing and Growth Considerations in Pediatric Facial Surgery. Int J Pediatr Otorhinolaryngol. 2018;107:101–107.
29. Posnick JC, et al. Condylar Fractures in Children: Remodeling and Management. J Craniofac Surg. 2005;16(2):243–251.
30. Johnson RL, Turner SR. Surgical Timing in Pediatric Facial Trauma. J Oral Maxillofac Surg. 2019; 77 (6):1220–1228.
31. Yang H, et al. 3D Printing in Pediatric Maxillofacial Surgery: Clinical Applications and Outcomes. J Craniofac Surg. 2022;33(1):101–108.
32. Lee J, et al. Preoperative 3D Models in Pediatric Facial Fractures. Int J Pediatr Otorhinolaryngol. 2021;144:110–116.

©2026 IJDSIR, All Rights Reserved

33. Kim Y, et al. Minimally Invasive Approaches in Pediatric Midface Fractures. J Oral Maxillofac Surg. 2020;78(8):1334–1342.
34. Tanaka N, et al. Endoscopic-assisted Reduction in Pediatric Orbital and Zygomatic Fractures. Plast Reconstr Surg. 2021;147(3):715–723.
35. Wang L, et al. AI-based Virtual Surgical Planning in Pediatric Maxillofacial Trauma. J Craniofac Surg. 2023;34(2):480–488.
36. Choi S, et al. Integration of AI and Virtual Planning in Pediatric Facial Surgery. Int J Pediatr Otorhinolaryngol. 2023;160:111–119

©2026 IJDSIR, All Rights Reserved